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Chapter 24

Optimization of Surface Roughness in High Speed End Milling of Titanium Alloy Ti-6Al-4V under Dry Condition

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1.0 INTRODUCTION

The techniques of High Speed Machining (HSM), while still in an initial stage of wide acceptance, have already been proven in leading aircraft manufacturing plants [1]. HSM has been applied successfully to materials like magnesium and aluminum. Among the titanium alloys, Ti-6Al-4V being the most commonly used and it is the workhorse alloy of the titanium industry, accounting for over 45% of the total titanium production [2]. Therefore, the efficiency of titanium machining is one of the major challenges in production engineering. Various studies have been conducted on the surface roughness in end milling of various materials using deferent cutting tools, experimental and optimization techniques. Baek et al [3] selected the optimal 181ederate using a bisection method. Peigne et al [4] studied effects of the cutting vibratory phenomena and their impacts on machined surface roughness. Franco et al [5] developed a numerical model for predicting the surface profile and surface roughness in face milling with round inserts. Alauddin et al [6] used RSM and ANOVA to optimize the surface finish in end-milling of Inconel 718. Only two cutting parameters (i.e., cutting speed and feed rate) were considered, and 13 experiments were conducted. An important parameter (depth of cut) was not considered. Choudhury et al [7] noticed that the surface finish improves with increase of the cutting speed at constant feed rate and constant depth of cut in machinability assessment of Inconel 718. Kuang-Hua Fuh and Chih-Fu Wu [8] used RSM for surface quality prediction in end milling of Al-alloy. Beside the usual cutting variables, they considered nose radius and flank width as parameters to be optimized.

In this study, 3-level full factorial experimental designs of RSM were used for high speed end milling of Ti-6Al-4V. The 3-level factorial method was used to study qualitatively the 3D (three dimensional) surface morphologies/topographies for the machined surfaces of Ti-6Al-4V to determine the machining conditions that could give the best possible surface finish. Desirability function of RSM was applied to optimize the cutting parameters.